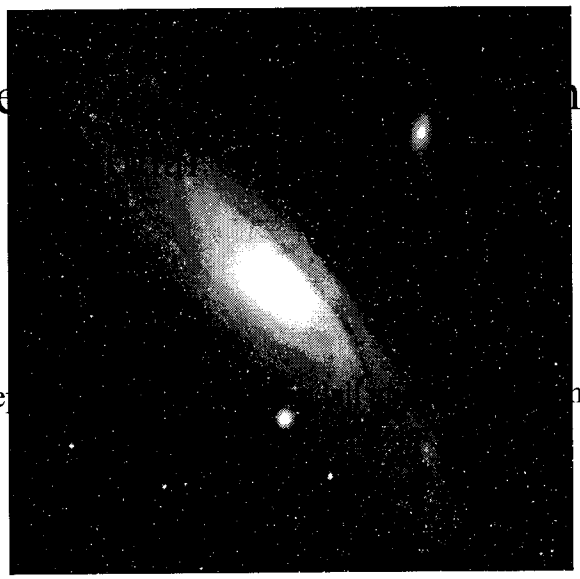
Supe nal

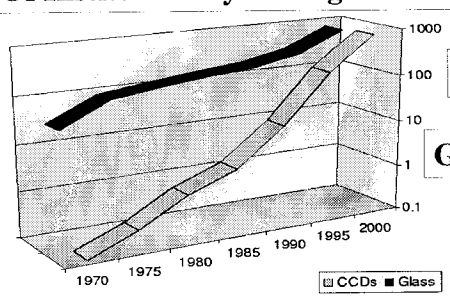


Jose han

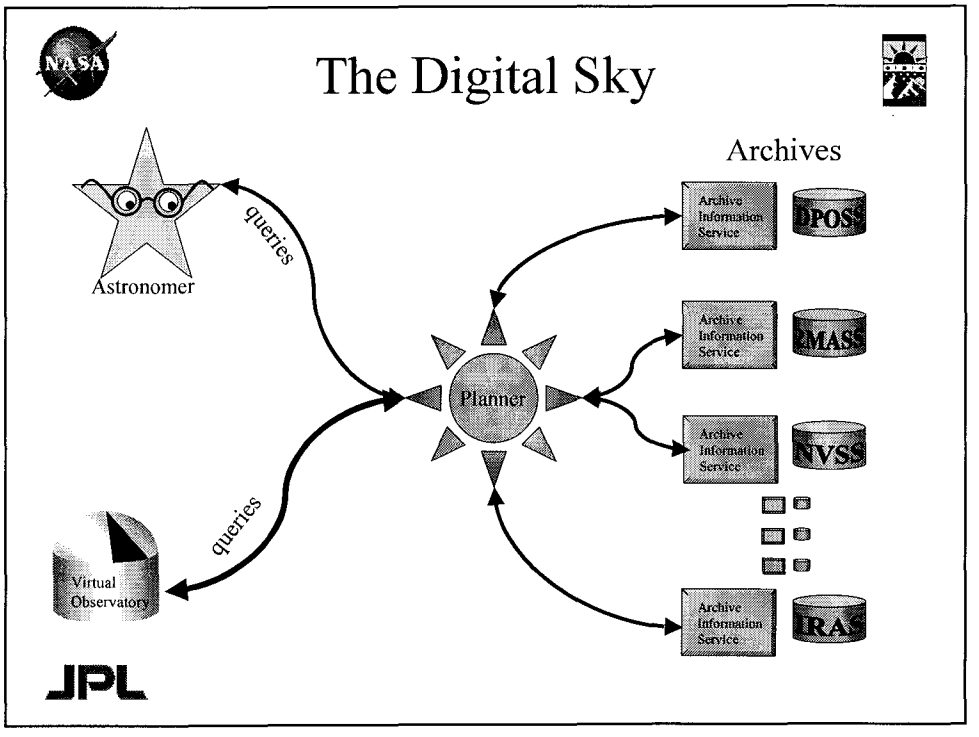
Space Science Applications of Information Technology Program
High Performance Computing and Communications Program

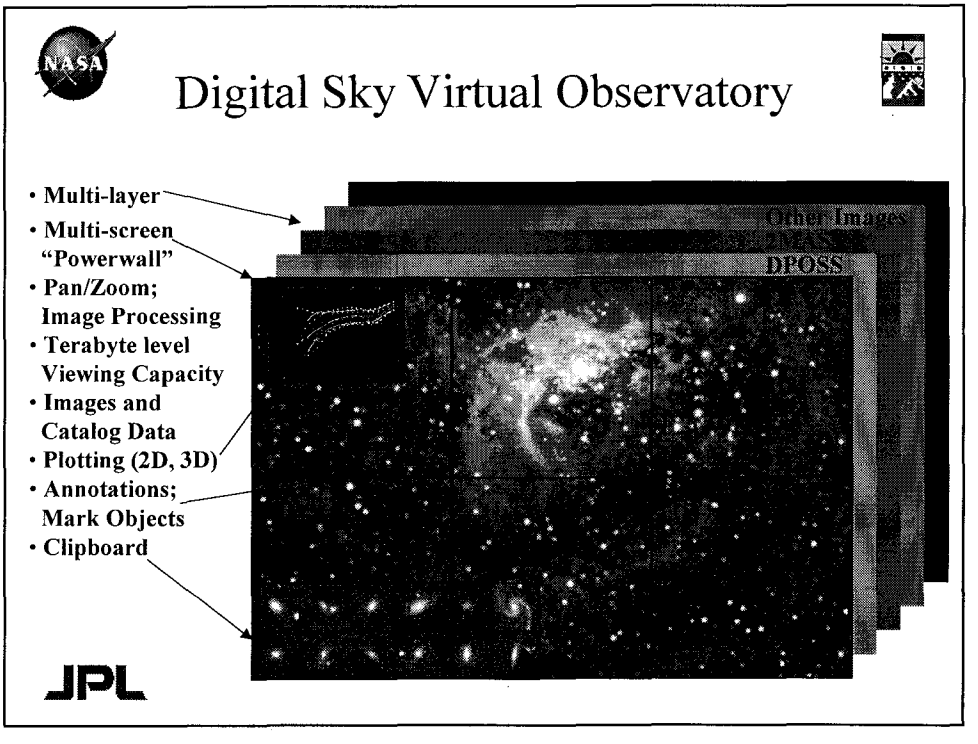
The Sky on Your Desktop

Growth in Aperture & Focal Plane Of Institutionally Managed Observatories



Goal:Deliver the data and its analysis to the individual astronomer's desktop

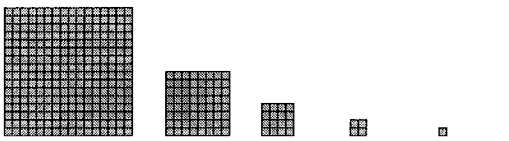

The Digital Sky
Archives
Astronomer
queries
queries
Planner
Virtual Observatory
Archive Information Service
DPOSS
Archive Information Service
2MASS
Archive Information Service
NVSS
Archive Information Service
IRAS
JPL


Digital Sky Virtual Observatory
• Multi-layer
• Multi-screen "Powerwall"
• Pan/Zoom; Image Processing
• Terabyte level Viewing Capacity
• Images and Catalog Data
• Plotting (2D, 3D)
• Annotations; Mark Objects
• Clipboard
Other Images
2MASS
DPOSS
JPL

Large Scale Data Input

Scalable IN:

- Hierarchical, tiled data storage and intelligent data caching for rapid data access at any location in the image and at any zoom level.



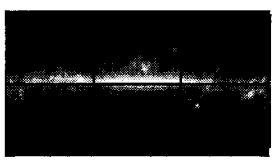
- Support for most popular image formats and can be easily expanded to support custom formats (example our hierarchical tiled image format and the FITS image format popular in the astronomical community.

JPL

Large Scale Data Output

Scalable OUT:

- Multi-screen Powerwall display.
- Single pipe or multi-pipe support.
- Support for any number of screens of any size.
- Supported display configurations are specified in a configuration file and are easily selectable at run-time with a command line option or by setting an environment variable.
- Software synchronization of the screens with MPI (multi-pipe case).
- High performance visualization demonstrated up to 3x2 Powerwall display.



3840x2048 pixels

- Low end support for visualization on user's workstation also provided.

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Large Image Navigation

- Smooth variable-speed panning with mouse or keyboard control.
- Smooth variable-speed zooming with keyboard control or zooming with GUI.
- Global Map View of the dataset shows a box around the region of the image currently visible. The user can click on the global view to jump to that position in the image.

Global Map View →

- User can jump to any position in the image based on pixel coordinate, right ascension/declination, galactic or ecliptic longitude/latitude.

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Multi-spectral Viewing

- Run-Time selection of bands to be mapped to each of the R, G and B video channels.
- In screen capture below, one 2MASS band is mapped to the red gun and DPOSS is mapped to green and blue. Stars that appear red are in the infrared only, those that appear cyan are in the optical only and those that appear white are present in both.

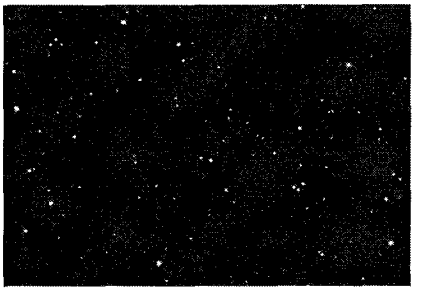

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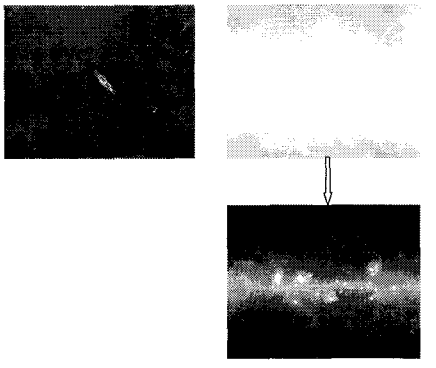
Image Enhancement

- Run-Time brightness and contrast adjustment can be applied to all three video channels (red, green and blue), or to any one channel individually.
- Brightness and contrast selectable with keyboard interface or GUI
- Example: Andromeda and the center of the Milky Way need vastly different brightness and contrast settings for optimal viewing (as illustrated below).



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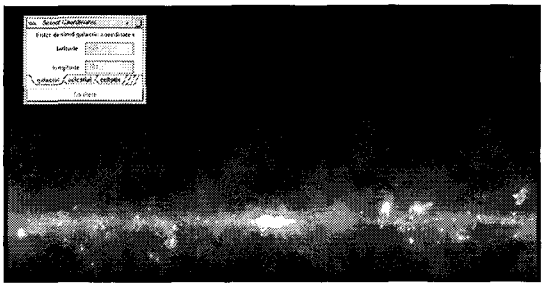
Pixel <>Sky Coordinates

- User may jump to a specific location in the image by specifying any of the following:
  - image pixel coordinates
  - right ascension/declination
  - galactic longitude/latitude
  - ecliptic longitude/latitude
- User may also get any of these values for a pixel in the image by simply clicking on the pixel at any zoom level.



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Overlays

- Support for image overlays that pan/zoom in concert with the image.
- Overlay shape and size can be fixed (user-selectable) or determined by the values in any column in the catalogs.

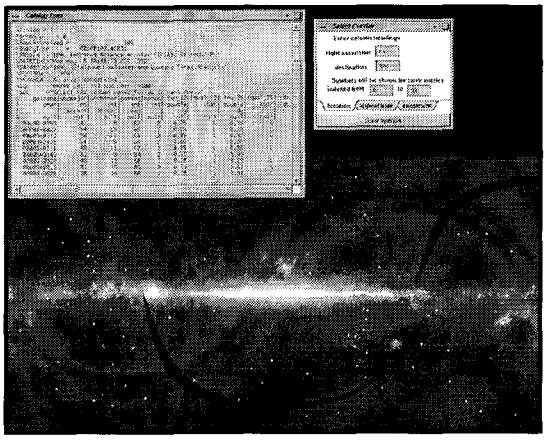

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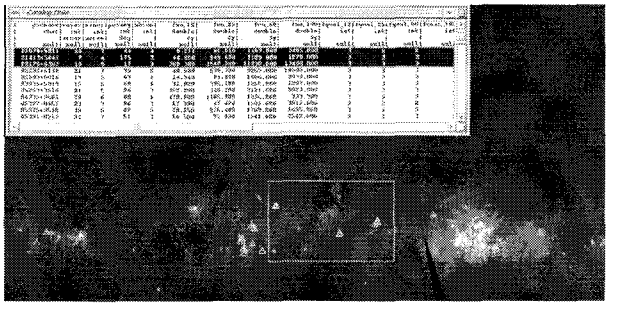
Image <> Catalog Relation

- Relating a location in the images to catalog entries for celestial objects in the proximity and vice versa.
- **Image to Catalog:** User may select a region of the sky and see the catalog entries for those objects in that region highlighted both in the image and in the catalog window.
- **Catalog to Image:** User may select a catalog entry and see that object highlighted in the image or jump to the position of that object in the image.



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Synthetic Maps

- A synthetic map of the sky may be generated from catalog information.
- Sky positions based on RA/Dec from catalog.
- Star brightness and size is based on (magnitude) values in a user-specified column of the catalog.
- An example map was constructed from the Hipparcos catalog, consisting of approximately 150,000 stars down to magnitude 14.

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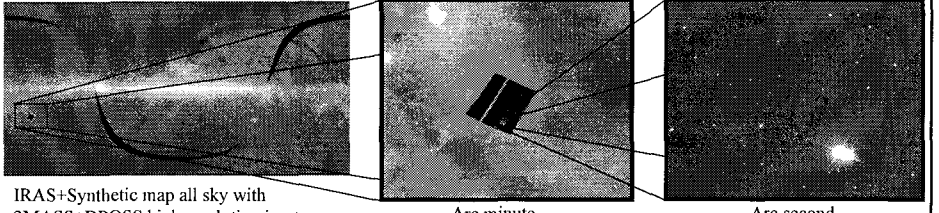
Automatic Dataset Compositing

SC2001

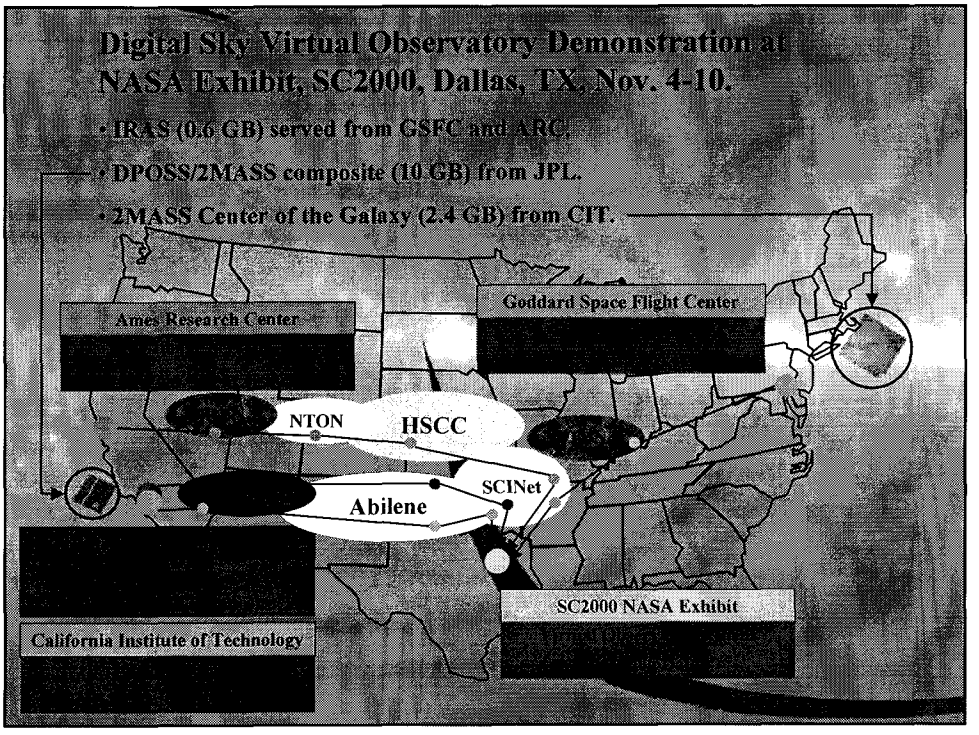
- Fully automated **run-time** compositing of multiple datasets, correctly positioned based on pixel resolution and latitude/longitude at a corner.
- Any number of datasets may be composited (although performance is degraded slightly with each one added).
- Allows user to do such things as view high-resolution insets of particular celestial objects or regions of the sky overlaid on top of lower resolution imagery of the whole sky.
- Example below shows screen captures of four composited datasets (IRAS, Hipparcos synthetic map, 2MASS, and DPOSS).



IRAS+Synthetic map all sky with 2MASS+DPOSS high resolution inset highlighted in the blue quadrilateral.

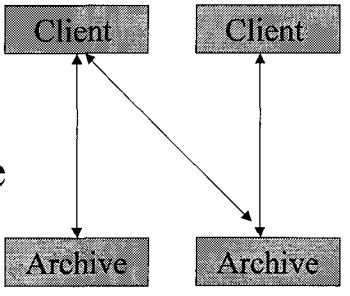
Arc minute

Arc second



NVO Architecture Connects Clients to Data

Simple Architecture



But the NVO needs more power and flexibility than this

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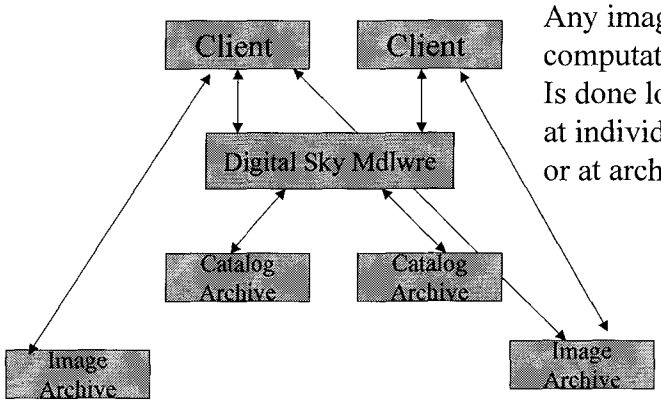
With Digital Sky



Any image analysis computation
Is done locally
at individual client
or at archive

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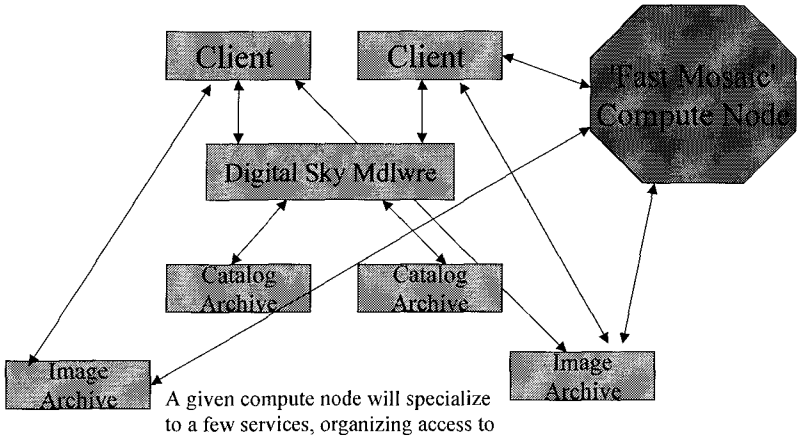
The digital sky middleware provides multi-archive catalog access and processing

With Compute Node



A given compute node will specialize to a few services, organizing access to computational facilities (and itself behaving as a client to provide multi-archive access), performing the computations for its specialized functions, e.g. image processing, intensive catalog cluster processing ,etc.

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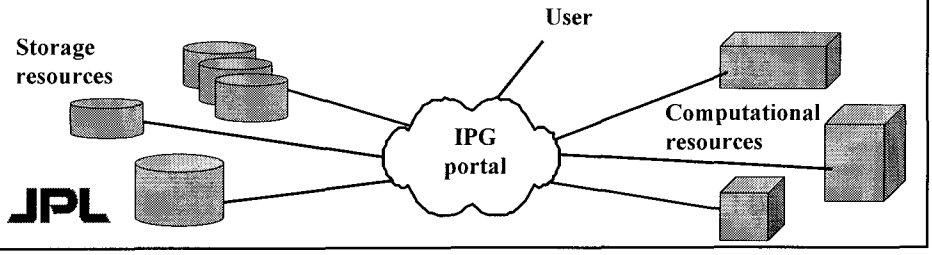
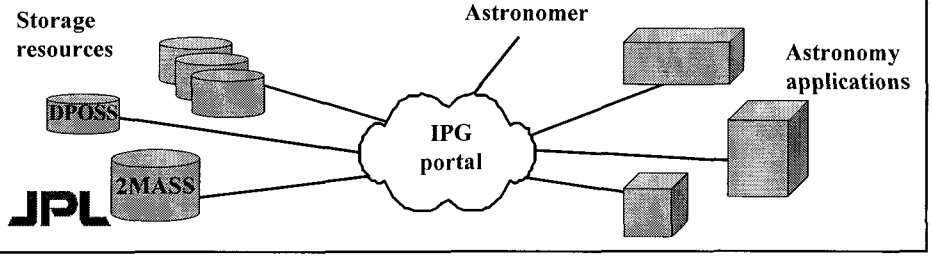
The Information Power Grid

- A single portal to access any of many distributed computational resources
- Large distributed storage facilities including the Storage Resource Broker at SDSC
- Connected by high performance networks
- Supports general purpose applications
- http://www.ipg.nasa.gov



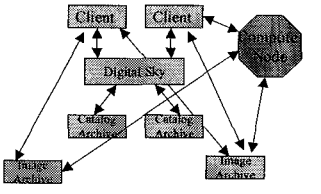
IPG and NVO a Natural Match

- Provide NVO astronomers access to the large astronomy datasets and high power processing of the data.
- Provide the middleware glue for a nationally distributed collection of image, object archives, computational power and high speed interlinks
- Help motivate & drive the IPG data intensive capability



Example: Custom 'On-the fly' Mosaic Node

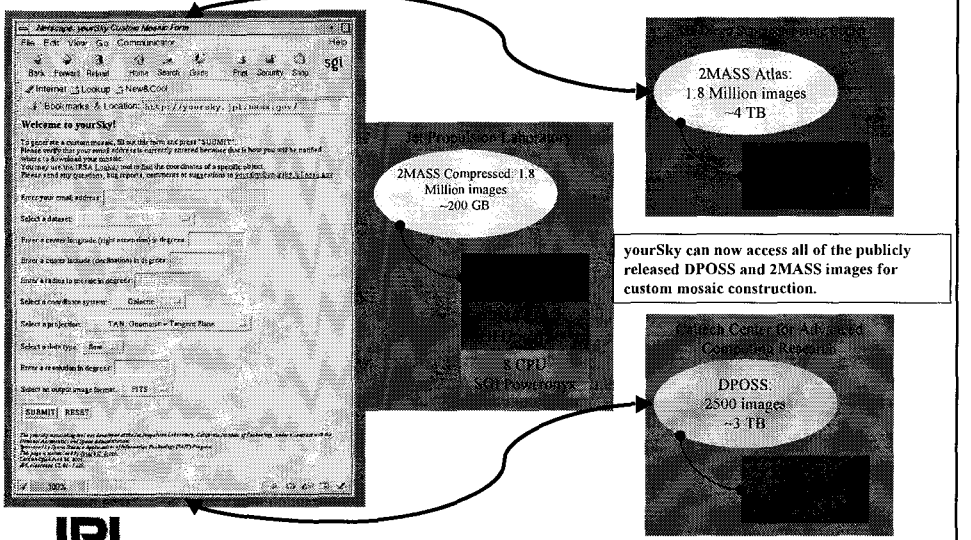
- Help for composing and focusing a mosaic request
  - Pre created all-sky, all-survey browseable mosaics of medium resolution.
  - Ingestion of catalog search results plotted on the sky.
- Building a custom mosaic:
  - A sky region and survey set are selected
  - The node reaches into the 'original' image archives.
  - Searches for available Grid computing resources
  - Performs the mosaicking with custom: resolution, projection, image processing rules, re-projected catalog results, blending rules, etc.
  - Returns results to original client.



JPL

yourSky Custom Mosaic Server

http://yoursky.jpl.nasa.gov



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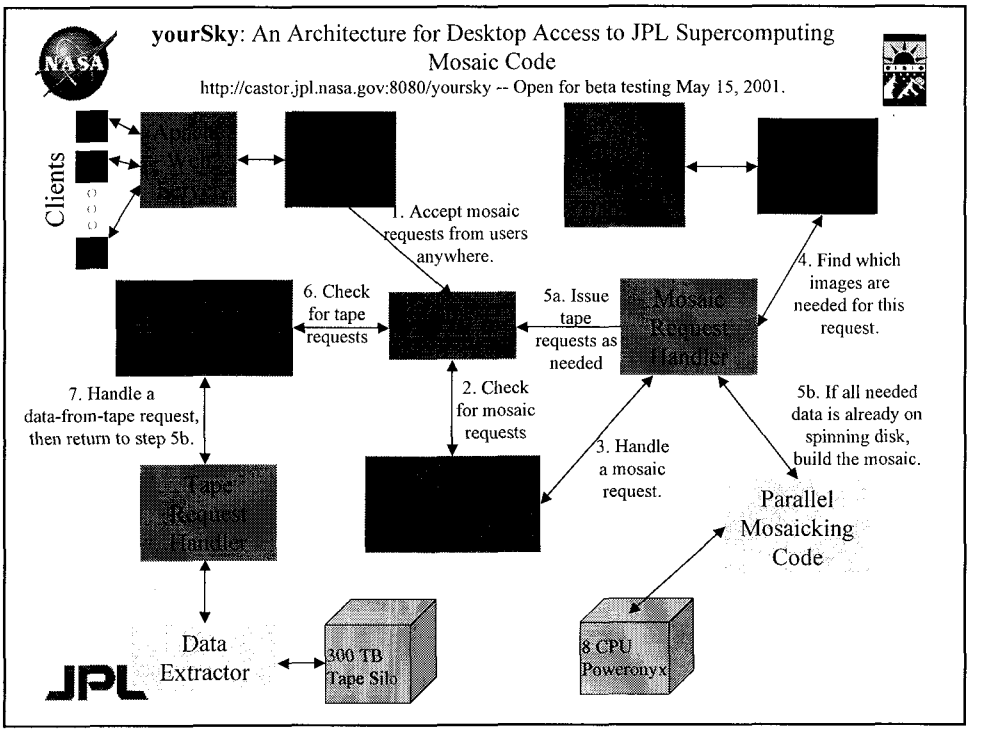
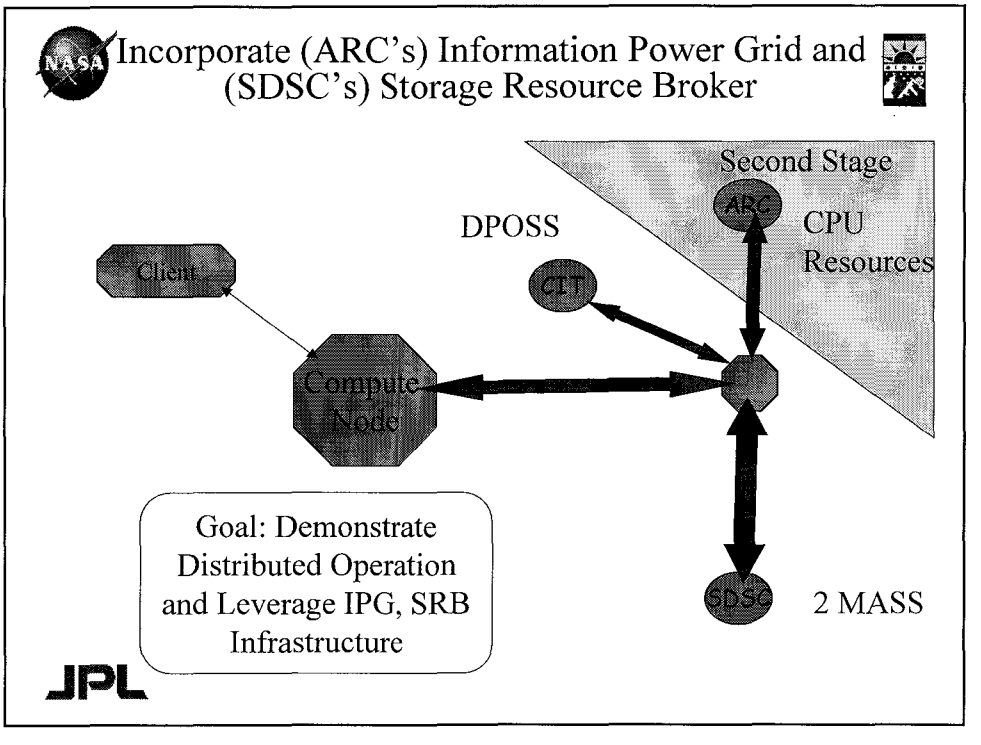

yourSky: An Architecture for Desktop Access to JPL Supercomputing Mosaic Code
http://castor.jpl.nasa.gov:8080/yoursky -- Open for beta testing May 15, 2001.
Clients
1. Accept mosaic requests from users anywhere.
4. Find which images are needed for this request.
6. Check for tape requests
5a. Issue tape requests as needed
Mosaic Request Handler
7. Handle a data-from-tape request, then return to step 5b.
2. Check for mosaic requests
3. Handle a mosaic request.
5b. If all needed data is already on spinning disk, build the mosaic.
Tape Request Handler
Parallel Mosaicking Code
Data Extractor
300 TB Tape Silo
8 CPU Powerenyx
JPL


Incorporate (ARC's) Information Power Grid and (SDSC's) Storage Resource Broker
Second Stage
ARC
CPU Resources
DPOSS
Client
CIT
Compute Node
SDSC
2 MASS
Goal: Demonstrate Distributed Operation and Leverage IPG, SRB Infrastructure
JPL